Electronics Engineering & Robotics I

2026-27 School year

Instructor: Michael Wolverton
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Location: **CEC Robotics & Computer Science Lab**
(D102 'Fabrication Lab')

Web Page: https://cec-code-lab.aps.edu

Times: **CEC Session II** (Mon. – Fri. 1:20-2:50 pm)

Course Description

Students have the opportunity to learn the science and engineering principles of automated machines, then apply them to build a simple robot. To gain the skills needed, students will learn about circuits and electricity, sensors and signal conditioning, logic circuitry, programming, and other electrical engineering concepts with both written work and hands on laboratories. After students begin to gain some of the essential skills, students will work on projects such as building and simple wheeled robots or automating light patterns. Primary course topics include:

- Basic Electronics
  - fundamentals of dc circuits and electricity
  - proper use of professional electronics tools to analyze circuits
  - wiring diagrams and reductive circuit analysis
  - dc motors principles and inductance
  - demonstrate logic circuits to understand how a microprocessor works
  - intro. to sensors, transducers and signal amplifiers
- Mechatronics
  - dc Motor control circuits
  - special dc motors (servo, stepper and brushless motors)
  - intro. to common rotary mechanisms (gears, lead-screws etc.)
  - proximity sensors (ultrasonic, infrared, lidar)
  - motion sensors, gyros and accelerometers
- Programming Fundamentals for Embedded Systems
  - c programming language
  - emphasis on logic, binary and functions
  - reading and leveraging formal documentation (API's)
  - flow control for embedded programming
  - basic digital logic signals for monitoring and output control
  - power output level control through pulse signals
  - voltage monitoring for sensors
  - pulse based communication for sending signals between chips
- Basic Robotics
  - small autonomous vehicles
  - sensor based navigation

Course Format

Electronics Engineering and Robotics I will operate as a *lab class* with associated lecture. A significant portion of the material will be presented by live hands on demonstrations, live coding demonstrations, and students are expected to do the vast majority of circuitry and programming exercises *in class* where instructor support is available. This means **regular attendance** is *extremely important*, and that students need to focus on being productive and focused when in class.

Fees, Learning Resources & Technology Requirements

There are no course fees for this school year.

An online circuit simulator, free open source software, reference documents, course information, assignment details and instructional videos will be at the course web page located at the web address below.

`https://cec-code-lab.aps.edu`

This course currently does not use a dedicated textbooks. Any excerpts or text references will be provided at the course web page.

Assignments & Grading Policy

Assignments

Graded items will typically fall into one of the below categories.

- Circuit Labs – Circuit labs will involve hands-on building, testing and measuring of described circuits as well as computer simulation of the circuit.
- Written Work – Written work will focus on circuit analysis, electrical calculations, descriptions and predictions of the behavior of electrical circuits described by diagram. Some later written work may also apply to programming.
- Code Assignments – Students will be issued an assignment document and due date. They must write a program that meets the objectives and technical criteria in the document. Typically some lecture, tutorials, hints or examples will be provided with each assignment to help students get started.
- Participation Grades – Students are expected to attend and participate in class work and activities unless excused. Students can be penalized for not participating (distracted by phone, etc.).
- Projects – Projects will involve construction, wiring, programming and testing of small vehicles or devices. However, the design may not be totally shown. Some of the elements of the project will be left up to the student to figure out by applying skills learned during labs.

Grading Weights

Overall grades are semester cumulative. All assignments will be point weighted, but the approximate makeup of a typical first semester grade is below. *Please note the exact fractions will change based on scheduling and logistics*.

0-59% **F**	60-69% **D**	70-79% **C**	80-89% **B**	90-100% **A**

Semester I Example Weights

Circuit Labs 40-60%	Written Work 20-30%	Coding Assignments 10-20%	Participation 0-20%

The second semester will involve much more in the way of projects and programming as we will have completed our basic electronics introduction and pure circuit labs.

Semester II Example Weights

Coding Assignments 40-60%	Projects 30-50%	Written Work 0-20%

Digital Distractions and Work Focus

We will be using computer resources such as the course web page, educational videos, circuit simulator, programming tools and programming reference web pages on a regular basis. *Classroom computers will be remotely monitored during class sessions*. Participation credit and assignment completion credit can be deducted for students engaging in gaming, recreational web surfing or watching video not relevant to programming tasks.

Code and Written Work Plagiarism

Submission of copied code, copied data without experimentation, or copied written work for credit will not be tolerated.

Assignments determined to contain plagiarized work will receive zero credit.

Students that submit plagiarized work may receive an overall failing grade and be referred to CEC administration.

The intent for code projects and assignments is to learn to program by writing code. Similarly, circuit labs are not meaningful without the hands-on element of actually constructing the circuit. Small blocks of code copied from our class reference materials or from previously completed assignments are acceptable, but students must write the vast majority of their code for credit. Similarly, discussion, comparison and group work and discussion in circuit labs is perfectly acceptable, while copying measurements and observations for a project which a student did not participate in is considered plagiarism.

CEC Cell Phone Policy

To create an optimal learning environment, cell phone use is to be limited to educational and medical purposes only. Teachers do have discretion to have students use cell phones for educational purposes. Students who need to use their cell phone for medical purposes must have documentation in Synergy.

Teacher Discretion

Teachers have the authority to establish specific cell phone rules in their classrooms. These rules must be communicated clearly to students in the course syllabus at the beginning of the term and must align with the overall school policy. Teachers will clearly communicate to students when the use of cell phones is allowed for educational purposes. Students who need to use their cell phone for medical purposes must have documentation in Synergy.

Consequences (per class)

1. First Offense: Verbal warning by teacher and confiscation of the cell phone for the remainder of the class. The Student will be reminded of classroom policy when they retrieve their phone.
2. Second Offense: Confiscation of the cell phone for the remainder of the Session, and the teacher will contact parent/guardian by phone or email that same day, and log contact in Synergy. Teacher will contact the front desk and a staff member will come to the classroom to retrieve, log and secure the confiscated phone until the end of the Session. The student will retrieve their phone from the front desk at the end of the Session.
3. Third Offense: Confiscation of the cell phone by front office staff, administrator contact with parent, and the parent must pick up the cell phone from school personnel.
4. Fourth Offense or Repeat Offenses in Multiple Classrooms: Administrator conference with parent/guardian and student. Student will not be allowed to bring a cell phone to the CEC Campus for the remainder of the school year. Violation will result in disciplinary action.

Emergency Use

Parents/guardians needing to contact students during school hours should do so through the front office.

CEC Front Office: (505) 247-3658 extension 45400

College Credit

In partnership with the University of New Mexico Electrical and Computer Engineering department, the Career Enrichment Center will be able to offer a college class credit for UNM ECE 131 Lab: Programming Fundamentals in addition to APS high school elective credit. The dual credit opportunity applies to the spring (second) semester. ***Note that dual credit enrollment is not guaranteed for all students****. Application for dual credit is dependent upon completion of extra assignments as well as good performance in the first semester. Dual credit applications can be rejected by the instructor or the UNM Dual Credit admissions office for a variety of reasons.* Students not approved for dual credit may remain enrolled as APS high school students receiving elective credit, as in the fall semester. Dual credit students will be assigned significantly more work, and graded more rigorously and need to work outside of class on additional assignments. A second syllabus will be issued at the start of second semester describing relevant changes in grading and classroom policy. Students can also enroll for UNM ECE 131 dual credit in Robotics 2 the following year if they choose to continue at CEC. This is generally a better option when available because it affords the student more time and support.

Tentative Curriculum Sequence

The class will progress through programming topics in the following order. Pacing will be adjusted based on the progression of the students. As such some units may be excluded or revisited as needed.

Unit I. Electronics

- Ohm's law, passive devices, multi-meters, field storage, batteries
- Time variance, alternating current, induction, motors, oscilloscope
- Active devices, logic circuits
- Transducers, sensors, amplifiers, signal conditioning

Unit II. C Programming

- variables, data types, binary, hex, macros
- flow control, logic, loops
- functions and c library file structure
- arrays and pointers
- command line i/o and text string manipulation
- data structures

Unit III. Microcontrollers & Mechatronics

- super-loop code structure, CPU delay timing, peripherals
- GPIO, buttons, indicators, basic device switching and reversible motor control
- Pulse width modulation and throttle control
- Time domain signals and r.c. servo motor control
- GPIO Interrupts and proximity sensors
- Stepper motor control and CNC devices

Unit IV. Simple Robot Vehicle Design

- two motor, one caster chassis
- line following by closed loop sensor navigation
- obstacle avoidance by closed loop sensor control